UNITED STATES PATENT AND TRADEMARK OFFICE

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Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

		Application No.	Applicant(s)
Office Action Summary		10/044,468	SHARMA ET AL.
		Examiner	Art Unit
		James A. Thompson	2625

-- *The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on _11 January 2002_.

2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) _1-31_ is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) _1-31_ is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☒ The drawing(s) filed on _11 January 2002_ is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a) ☐ All b) ☐ Some * c) ☐ None of:

      1. ☐ Certified copies of the priority documents have been received.

      2. ☐ Certified copies of the priority documents have been received in Application No. _____.

      3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _01/11/02_.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1.   The following is a quotation of the appropriate paragraphs
of 35 U.S.C. 102 that form the basis for the rejections under
this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (e) the invention was described in (1) an application for patent,
> published under section 122(b), by another filed in the United States
> before the invention by the applicant for patent or (2) a patent
> granted on an application for patent by another filed in the United
> States before the invention by the applicant for patent, except that an
> international application filed under the treaty defined in section
> 351(a) shall have the effects for purposes of this subsection of an
> application filed in the United States only if the international
> application designated the United States and was published under
> Article 21(2) of such treaty in the English language.

2.   Claims 1-3, 25-26 and 28 are rejected under 35
U.S.C. 102(e) as being anticipated by Gotoh (US Patent
Application Publication 2002/0024548 A1).

Regarding claim 1: Gotoh discloses a method of halftoning
for multi-pass rendering, wherein different pixel locations are
rendered in each pass (para. 69, lines 1-5 of Gotoh), the method
comprising restricting a substantial majority of the pixels
turned on to render a tone to the minimum number of passes
required to produce the tone (para. 71, lines 5-9 of Gotoh). In
the example given, half of the turned-on pixels are printed in
two passes (para. 71, lines 5-9 of Gotoh). Thus, only one-
quarter of the turned-on pixels are printed in a single pass.
Therefore, three-quarters of the turned-on pixels are restricted
from being printed.

Regarding claim 2: Gotoh discloses that the substantial
majority is approximately 75% or more of the pixels turned on to
render a tone (para. 71, lines 5-9 of Gotoh). As discussed in

the arguments regarding claim 1, three-quarters (75%) of the turned-on pixels are restricted from being printed.

Regarding claim 3: Gotoh discloses that the substantial majority is approximately 90% or more of the pixels turned on to render a tone (para. 72, lines 5-9 and para. 73, lines 4-9 of Gotoh). In the case of 64 nozzles, only 1.5625% of the turned-on pixels are printed with a single nozzle. Thus, more than 90% of the turned-on pixels are restricted from being printed so that, with two sets of 32 nozzles (para. 73, lines 4-9 of Gotoh), a tone can be rendered in the minimum number of passes.

Regarding claim 25: Gotoh discloses a method comprising restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (para. 71, lines 5-9 of Gotoh). In the example given, half of the turned-on pixels are printed in two passes (para. 71, lines 5-9 of Gotoh). Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.

Regarding claim 26: Gotoh discloses generating a screen pixel turn-on sequence (figure 26 and para. 79-80 of Gotoh); and partitioning the turn-on sequence into a plurality of partitions (figure 21C; figure 26(8B,8C); and para. 80 of Gotoh) corresponding to rendering passes (para. 72, lines 4-7 and para. 81 of Gotoh), wherein the restricting step includes re-ordering the pixel turn-on sequence (para. 80 of Gotoh). By switching blocks of the gray scale pattern (para. 80 of Gotoh), the screen pixel turn-on sequence is re-ordered.

Regarding claim 28: Gotoh discloses a system (figure 16 and para. 49 of Gotoh) comprising means for restricting a

substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (para. 71, lines 5-9 of Gotoh). In the example given, half of the turned-on pixels are printed in two passes (para. 71, lines 5-9 of Gotoh). Thus, only one-quarter of the turned-on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.

Claim Rejections - 35 USC § 103

3.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4.   Claims 4-10, 27 and 29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gotoh (US Patent Application Publication 2002/0024548 A1) in view of Wang (US Patent 6,014,500).

Regarding claim 4: Gotoh discloses generating a screen pixel turn-on sequence (figure 26 and para. 79-80 of Gotoh); and partitioning the screen pixel turn-on sequence into a plurality of partitions (figure 21C; figure 26(8B,8C); and para. 80 of Gotoh), wherein each partition corresponds to a different pass (para. 72, lines 4-7 and para. 81 of Gotoh).

Gotoh does not disclose expressly that said screen pixel turn on sequence is specifically a stochastic screen pixel turn on sequence.

Wang discloses generating a stochastic screen pixel turn-on sequence (column 5, lines 52-56 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence, as taught by Wang. The suggestion for doing so would have been that stochastic screens provide the highest resolutions at all possible levels with all possible orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 4.

Regarding claim 5: Gotoh discloses re-ordering the screen pixel turn-on sequence (para. 80 of Gotoh) to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (figure 21C and para. 71, lines 5-9 of Gotoh). By switching blocks of the gray scale pattern (para. 80 of Gotoh), the screen pixel turn-on sequence is re-ordered.

As demonstrated in the arguments regarding claim 4, combining the teachings of Wang with Gotoh provides for the halftone screen taught by Gotoh being specifically a stochastic halftone screen.

Regarding claim 6: Gotoh discloses generating a halftone screen (figure 26 of Gotoh) using the re-ordered screen pixel turn-on sequence (para. 79-80 of Gotoh). The gray scale patterns (figure 26 of Gotoh) are clearly halftone screens since

they are used to determine which dots are printed for a corresponding gray level value.

As demonstrated in the arguments regarding claim 4, combining the teachings of Wang with Gotoh provides for the halftone screen taught by Gotoh being specifically a stochastic halftone screen.

Regarding claim 7: Gotoh does not disclose expressly that the re-ordering step including placing the lowest stochastic screen pixel turn-on sequence values in one partition and the highest stochastic screen pixel turn-on values in another partition.

Wang discloses placing the lowest stochastic screen pixel turn-on sequence values in one partition and the highest stochastic screen pixel turn-on values in another partition (column 7, lines 30-40 of Wang). The stochastic screen pixel turn-on sequence values are partitioned into checkerboard and reverse-checkerboard partitions (column 7, lines 30-40 of Wang). Since first half (S_1) turn-on sequence is in checkerboard form, then the first partition must be the lowest stochastic screen pixel turn-on sequence values and the second half (S_2) must be the highest stochastic screen pixel turn-on sequence values.

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence in the partitioning order taught by Wang. The suggestion for doing so would have been that the stochastic screens taught by Wang provide the highest resolutions at all possible levels with all possible orientations, and therefore

produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 7.

Regarding claim 8: Gotoh discloses that a checkerboard pattern is used for printing the individual pixels of the first partition, and then a reverse checkerboard pattern is used for printing the individual pixels of the second partition (figure 21C and para. 72, lines 9-19 of Gotoh).

Gotoh does not disclose expressly (a) replacing the lowest stochastic screen pixel turn-on value before re-ordering contained in one partition with a replacement value which is the lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (b) replacing the next lowest stochastic screen pixel turn-on value in the one partition with a replacement value which is the next lowest stochastic screen pixel turn-on sequence value of all partitions of the screen; (c) repeating step (b) until the one partition is filled with the lowest stochastic screen pixel turn-on sequence values of all partitions; and (d) repeating steps (a) through (c) to re-order each of the other partitions in turn with the remaining unused replacement values.

Wang discloses re-ordering the stochastic screen pixel turn-on values (column 5, lines 52-61 of Wang) to optimize a merit function and thus minimize the level of moiré (column 7, lines 44-55 of Wang) based on a checkerboard pattern (column 7, lines 28-34 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary

skill in the art to re-order the stochastic screen pixel turn-on
sequence values according to a checkerboard pattern, as taught
by Wang, based specifically on the ordering of the checkerboard
pattern (partition 1) and inverted checkerboard pattern
(partition 2) taught by Gotoh. Since the pattern (figure 21C of
Gotoh) prints in an order of alternating dots, the re-ordering
performed according to the teachings of Wang (column 5, lines
52-61 of Wang) would be performed to produce the same pattern
(figure 21C of Gotoh; and column 7, lines 28-34 of Wang). Thus,
the re-ordering would be performed such that (a) the lowest
stochastic screen pixel turn-on value is replaced before re-
ordering contained in one partition with a replacement value
which is the lowest stochastic screen pixel turn-on sequence
value of all partitions of the screen; (b) the next lowest
stochastic screen pixel turn-on value is replaced in the one
partition with a replacement value which is the next lowest
stochastic screen pixel turn-on sequence value of all partitions
of the screen; (c) step (b) is repeated until the one partition
is filled with the lowest stochastic screen pixel turn-on
sequence values of all partitions; and (d) steps (a) through (c)
are repeated to re-order each of the other partitions in turn
with the remaining unused replacement values. The motivation
for doing so would have been that the optimization taught by
Wang eliminates moiré between the input and the screen (column
7, lines 25-30 of Wang). Therefore, it would have been obvious
to combine Wang with Gotoh to obtain the invention as specified
in claim 8.

    Regarding claim 9: Gotoh discloses that a checkerboard
pattern is used for printing the individual pixels of the first
partition, and then a reverse checkerboard pattern is used for

printing the individual pixels of the second partition (figure 21C and para. 72, lines 9-19 of Gotoh).

Gotoh does not disclose expressly (a) obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order of turn-on sequence values; (b) concatenating the subsequences for the different partitions, in any order, to form a single sequence; and (c) renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence.

Wang discloses re-ordering the stochastic screen pixel turn-on values (column 5, lines 52-61 of Wang) to optimize a merit function and thus minimize the level of moiré (column 7, lines 44-55 of Wang) based on a checkerboard pattern (column 7, lines 28-34 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to re-order the stochastic screen pixel turn-on sequence values according to the order of the checkerboard pattern (partition 1) and inverted checkerboard pattern (partition 2), as taught by Wang, based specifically on the ordering of the checkerboard pattern taught by Gotoh. Since the pattern (figure 21C of Gotoh) prints in a specific order with respect to each partition, the re-ordering performed according to the teachings of Wang (column 5, lines 52-61 of Wang) would be performed to produce the same pattern (figure 21C of Gotoh; and column 7, lines 28-34 of Wang). Thus, the re-ordering would be performed by (a) obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order

of turn-on sequence values; (b) concatenating the subsequences for the different partitions, in any order, to form a single sequence; and (c) renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence.   The motivation for doing so would have been that the optimization taught by Wang eliminates moiré between the input and the screen (column 7, lines 25-30 of Wang).   Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 9.

Regarding claim 10:   Gotoh discloses partitioning the screen pixel turn-on sequence into two partitions (figure 26 (8B,8C) and para. 79-80 of Gotoh).

As demonstrated in the arguments regarding claim 4, combining the teachings of Wang with Gotoh provides for the halftone screen taught by Gotoh being specifically a stochastic halftone screen.

Regarding claim 27:   Gotoh does not disclose expressly that the step of generating a pixel turn-on sequence includes optimizing a merit function representative of the halftone texture quality.

Wang discloses optimizing a merit function representative of the halftone texture quality (column 7, lines 44-49 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data.   At the time of the invention, it would have been obvious to a person of ordinary skill in the art to use and optimize the specific merit function taught by Wang.   The suggestion for doing so would have been that the stochastic screens taught by Wang provide the highest resolutions at all possible levels with all possible

orientations, and therefore produce images with the best detail (column 2, lines 13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh to obtain the invention as specified in claim 27.

Regarding claim 29: Gotoh discloses a screen pixel turn-on sequence generator (figure 26 and para. 79-80 of Gotoh); and means for partitioning the screen pixel turn-on sequence into a plurality of partitions (figure 21C; figure 26(8B,8C); and para. 80 of Gotoh) each partition corresponding to a different pass (para. 72, lines 4-7 and para. 81 of Gotoh), wherein the restricting means includes means for re-ordering the screen pixel turn-on sequence (para. 80 of Gotoh) to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone (figure 21C and para. 71, lines 5-9 of Gotoh). By switching blocks of the gray scale pattern (para. 80 of Gotoh), the screen pixel turn-on sequence is re-ordered.

Gotoh does not disclose expressly that said screen pixel turn on sequence is specifically a stochastic screen pixel turn on sequence.

Wang discloses generating a stochastic screen pixel turn-on sequence (column 5, lines 52-56 of Wang).

Gotoh and Wang are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to specifically generate a stochastic screen pixel turn-on sequence, as taught by Wang. The suggestion for doing so would have been that stochastic screens provide the highest resolutions at all possible levels with all possible

orientations, and therefore produce images with the best detail
(column 2, lines 13-19 of Wang). Therefore, it would have been
obvious to combine Wang with Gotoh to obtain the invention as
specified in claim 29.

5.   Claims 11-14 are rejected under 35 U.S.C. 103(a) as being
unpatentable over Gotoh (US Patent Application Publication
2002/0024548 A1) in view of Wang (US Patent 6,014,500) and
obvious engineering design choice.

Regarding claim 11: Gotoh does not disclose expressly that
the partitions are designated S_1 and S_2 and the merit function is
$\tilde{M}(S) = M(S) + w_1 * M(S_1) + w_2 * M(S_2)$, where $M(S)$ is a merit function
suitable for a single stochastic screen and w_1 and w_2 are
weighting factors in the range of 2 to approximately 100.

Wang discloses that the partitions are designated S_1 and S_2
and the merit function is $\tilde{M}(S) = M(S) + w_1 * M(S_1) + w_2 * M(S_2)$, where
$M(S)$ is a merit function suitable for a single stochastic screen
(column 7, lines 42-53 of Wang) and w_1 and w_2 are weighting
factors (column 7, lines 54-55 of Wang).

Gotoh and Wang are combinable because they are from the
same field of endeavor, namely halftone screen generation and
halftone printing of digital image data. At the time of the
invention, it would have been obvious to a person of ordinary
skill in the art to use the specific merit function taught by
Wang. The suggestion for doing so would have been that the
stochastic screens taught by Wang provide the highest resolu-
tions at all possible levels with all possible orientations, and
therefore produce images with the best detail (column 2, lines

13-19 of Wang). Therefore, it would have been obvious to combine Wang with Gotoh.

Gotoh in view of Wang does not disclose expressly that the weighting factors are in the range of 2 to approximately 100. However, it would have been an obvious engineering design choice to set the weighting factors in the range of 2 to approximately 100. Firstly, the weighting factors are set for the purpose of balancing the overall quality and moiré removal (column 7, lines 54-55 of Wang). Secondly, the exact weighting values depend, at least in part, on how the function $M(S)$ is specifically defined. Setting the weighting values to 3 or 0.3 or 0.0003 or 300000 (for example) depends upon factors such as how the density values are expressed, the range of the density values, and the physical units applied when using the equation to obtain a specific result. Thus, setting the weighting values would simply be an operation that one of ordinary skill in the art at the time of the invention would perform for the purpose of practicing the system set forth by Gotoh in view of Wang. Therefore, it would have been obvious to implement the obvious engineering design choice in the system of Gotoh in view of Wang to obtain the invention as specified in claim 11.

Further regarding claim 12: Wang discloses that the partitioning step includes partitioning into a checkerboard partition arrangement (column 7, lines 25-30 of Wang).

Further regarding claim 13: Wang discloses generating a halftone screen for a checkerboard partition (column 7, lines 25-30 of Wang) such that the pixels can be classified as belonging to the two partitions using the coordinates of columns and rows, i and j, and the mathematical rule $p(i,j) \in S_1, if(i,j)\%2 = 0$; $p(i,j) \in S_2, if(i,j)\%2 = 1$; $S = S_1 + S_2$ (column 7, lines 30-41 of Wang) and

optimizing the merit function $\tilde{M}(S) = M(S) + w_1 * M(S_1) + w_2 * M(S_2)$, where w_1 and w_2 are weighting factors (column 7, lines 44-55 of Wang).

As discussed above in the arguments regarding claim 11, it would have been an obvious design choice to set w_1 and w_2 in the range of 2 to approximately 100.

Regarding claim 14: Gotoh in view of Wang does not disclose expressly that $w_1 \approx 3$ and $w_2 \approx 3$. However, it would have been an obvious engineering design choice to set the weighting factors such that $w_1 \approx 3$ and $w_2 \approx 3$. Firstly, the weighting factors are set for the purpose of balancing the overall quality and moiré removal (column 7, lines 54-55 of Wang). Secondly, the exact weighting values depend, at least in part, on how the function $M(S)$ is specifically defined. Setting the weighting values to 3 or 0.3 or 0.0003 or 300000 (for example) depends upon factors such as how the density values are expressed, the range of the density values, and the physical units applied when using the equation to obtain a specific result. Thus, setting the weighting values would simply be an operation that one of ordinary skill in the art at the time of the invention would perform for the purpose of practicing the system set forth by Gotoh in view of Wang. Therefore, it would have been obvious to implement the obvious engineering design choice in the system of Gotoh in view of Wang to obtain the invention as specified in claim 14.

6.   Claims 15-24 and 30-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Gotoh (US Patent Application Publication 2002/0024548 A1) in view of Shiau (US Patent 5,880,857).

Regarding claim 15: Gotoh discloses providing an input
image having a plurality of pixels each having an input tone
value (para. 61, lines 7-10 of Gotoh); and partitioning the
input image pixels into partitions (figure 21C; figure 26(8B,
8C); and para. 80 of Gotoh) wherein each partition corresponds
to a different pass (para. 72, lines 4-7 and para. 81 of Gotoh).

Gotoh does not disclose expressly adding an error diffused
from previously processed pixels to the input tone value of a
current pixel to achieve a desired pixel value; and comparing
the desired pixel value with a threshold value, wherein the
restricting step includes adding a zero mean bias signal to the
input tone value based on the partition containing the input
image pixel.

Shiau discloses adding an error diffused from previously
processed pixels to the input tone value of a current pixel to
achieve a desired pixel value (column 4, lines 18-20 of Shiau);
and comparing the desired pixel value with a threshold value
(column 4, lines 9-13 of Shiau), wherein the restricting step
includes adding a zero mean bias signal to the input tone value
based on the partition containing the input image pixel (column
3, lines 62-66 and column 5, lines 11-19 of Shiau). Since the
generated random noise added to the tone level has a random
value between plus and minus 255 for 256 potential gray levels,
which is then multiplied by a constant positive factor for each
corresponding gray level, the random noise signal has zero mean
bias.

Gotoh and Shiau are combinable because they are from the
same field of endeavor, namely halftone screen generation and
halftone printing of digital image data. At the time of the
invention, it would have been obvious to a person of ordinary

skill in the art to apply error diffusion using random values
with a zero mean bias, as taught by Shiau. The motivation for
doing so would have been to eliminate pattern shifting artifacts
in the resultant printed image (column 2, lines 42-43 of Shiau).
Therefore, it would have been obvious to combine Shiau with
Gotoh to obtain the invention as specified in claim 15.

Regarding claim 20: Gotoh discloses providing an input
image having a plurality of pixels each having an input tone
value (para. 61, lines 7-10 of Gotoh); and partitioning the
input image pixels into partitions (figure 21C; figure
26(8B,8C); and para. 80 of Gotoh) wherein each partition
corresponds to a different pass (para. 72, lines 4-7 and para.
81 of Gotoh).

Gotoh does not disclose expressly adding an error diffused
from previously processed pixels to the input tone value of a
current pixel to achieve a desired pixel value; and comparing
the desired pixel value with a threshold value, wherein the
restricting step includes adding a zero mean bias signal to the
threshold value based on the partition containing the input
image pixel.

Shiau discloses adding an error diffused from previously
processed pixels to the input tone value of a current pixel to
achieve a desired pixel value (column 4, lines 18-20 of Shiau);
and comparing the desired pixel value with a threshold value
(column 4, lines 9-13 of Shiau), wherein the restricting step
includes adding a zero mean bias signal to the threshold value
(column 3, lines 62-66 and column 4, lines 30-34 of Shiau) based
on the partition containing the input image pixel (column 5,
lines 11-19 of Shiau). Since the generated random noise added
to the tone level has a random value between plus and minus 255

for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias.

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 20.

Regarding claims 16 and 21: Gotoh discloses partitioning the input image pixels into two partitions (figure 26(8B,8C) and para. 79-80 of Gotoh).

Regarding claims 17-18 and 22-23: Gotoh discloses partitioning the input image pixels into a checkerboard partition (figure 21 and para. 72, lines 9-13 of Gotoh).

Gotoh does not disclose expressly that the zero mean bias signal has a value of +D for one partition and -D for the other partition.

Shiau discloses that the zero mean bias signal has a value of +D (e.g. +20) for a first section of input data and -D (e.g. -20) for a second section of input data (column 8, lines 15-25 of Shiau).

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary

skill in the art to use a bias of +D for one partition and a
bias of -D for another partition, as taught by Shiau. The
motivation for doing so would have been to be able to properly
apply the correct amount of perturbing noise (column 8, lines
50-55 of Shiau), thus helping to eliminate pattern shifting
artifacts in the resultant printed image (column 2, lines 42-43
of Shiau). Therefore, it would have been obvious to combine
Shiau with Gotoh to obtain the invention as specified in claims
17-18 and 22-23.

Further regarding claims 19 and 24: Shiau discloses that
the input image tone value can be one of 256 values (0 to 255)
(column 7, lines 25-29 of Shiau) and the value of D is between
approximately 32 and 64 (column 5, lines 15-26 of Shiau). For
the case of a grey value of 85, the coefficient is 0.5.
Therefore, for a random noise value of plus or minus 128, the
value of D is 64, and for a random noise value of plus or minus
64, the value of D is 32.

Regarding claim 30: Gotoh discloses means for partitioning
an input image having a plurality of input pixel tone values
(para. 61, lines 7-10 of Gotoh) into a plurality of partitioned
pixel tone values (figure 21C; figure 26(8B,8C); and para. 79-80
of Gotoh).

Gotoh does not disclose expressly means for processing the
partitioned pixel tone values to produce a previously processed
pixel error diffusion value; means for processing a current
partitioned input pixel tone value including means for adding
the previously processed pixel error diffusion value to the
current partitioned input pixel tone value to achieve a desired
pixel value; and means for comparing the desired pixel value
with a threshold value to produce an output signal for rendering

the image, wherein the means for restricting includes means for adding a zero mean bias signal being based on the partition containing the partitioned pixel tone value.

Shiau discloses means for processing pixel tone values to produce a previously processed pixel error diffusion value (column 4, lines 18-20 of Shiau); means for processing a current input pixel tone value including means for adding the previously processed pixel error diffusion value to the current input pixel tone value of a current pixel to achieve a desired pixel value (column 4, lines 18-20 of Shiau); and means for comparing the desired pixel value with a threshold value (column 4, lines 9-13 of Shiau) to produce an output signal for rendering the image (column 4, lines 12-18 of Shiau), wherein the means for restricting includes means for adding a zero mean bias signal being based on the partition containing the partitioned pixel tone value (column 3, lines 62-66 and column 5, lines 11-19 of Shiau). Since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias.

Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau, to the partitions taught by Gotoh. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would

have been obvious to combine Shiau with Gotoh to obtain the
invention as specified in claim 30.

Regarding claim 31: Gotoh discloses means for partitioning
an input image having a plurality of input pixel tone values
(para. 61, lines 7-10 of Gotoh) into a plurality of partitioned
pixel tone values (figure 21C; figure 26(8B,8C); and para. 79-80
of Gotoh).

Gotoh does not disclose expressly means for processing the
partitioned pixel tone values to produce a previously processed
pixel error diffusion value; means for processing a partitioned
input pixel tone value including means for adding the previously
processed pixel error diffusion value to the partitioned input
pixel tone value to achieve a desired pixel value; and means for
comparing the desired pixel value with a threshold value to
produce an output signal for rendering the image, wherein the
means for restricting includes means for adding a zero mean bias
signal to the threshold value, the zero mean bias signal being
based on the partition containing the partitioned pixel tone
value.

Shiau discloses means for processing pixel tone values to
produce a previously processed pixel error diffusion value
(column 4, lines 18-20 of Shiau); means for processing an input
pixel tone value including means for adding the previously
processed pixel error diffusion value to the input pixel tone
value of a current pixel to achieve a desired pixel value
(column 4, lines 18-20 of Shiau); and means for comparing the
desired pixel value with a threshold value (column 4, lines 9-13
of Shiau) to produce an output signal for rendering the image
(column 4, lines 12-18 of Shiau), wherein the means for
restricting includes means for adding a zero mean bias signal to

the threshold value (column 3, lines 62-66 and column 4, lines 30-34 of Shiau), the zero mean bias function being based on the partition containing the partitioned pixel tone value (column 5, lines 11-19 of Shiau). Since the generated random noise added to the tone level has a random value between plus and minus 255 for 256 potential gray levels, which is then multiplied by a constant positive factor for each corresponding gray level, the random noise signal has zero mean bias.
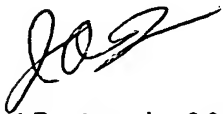
Gotoh and Shiau are combinable because they are from the same field of endeavor, namely halftone screen generation and halftone printing of digital image data. At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply error diffusion using random values with a zero mean bias, as taught by Shiau, to the partitions taught by Gotoh. The motivation for doing so would have been to eliminate pattern shifting artifacts in the resultant printed image (column 2, lines 42-43 of Shiau). Therefore, it would have been obvious to combine Shiau with Gotoh to obtain the invention as specified in claim 31.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James A. Thompson whose telephone number is 571-272-7441. The examiner can normally be reached on 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David K. Moore can be reached on 571-272-7437. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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17 March 2006

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